BULLETIN

OF THE INSTITUTE OF METALS

VOLUME 5 DECEMBER 1960 PART 16

INSTITUTE NEWS

Titles of Papers for the Journal

The Editorial Board and Publication Committee wish to impress on authors the need for a careful choice of title in papers submitted for the *Journal*. A number of cases have been noted recently in which papers have borne titles that give no indication of the practical significance of the work described. Titles should be short and, if desired, followed by an explanatory sub-title.

Authors are accordingly urged, wherever possible, to bring out any practical aspects their work may have by a suitable choice of wording for the title. When necessary, the Publication Committee proposes to suggest improvements to authors.

Lecture on "Metallurgical Research at High Pressures"

Dr. J. E. HILLIARD, of the Research Laboratory, General Electric Co., Schenectady, U.S.A., will give a lecture on "Metallurgical Research at High Pressures" at 17 Belgrave Square, London, S.W.1, at 6.30 p.m. on Thursday, 12 January 1961.

The lecture is being given under the auspices of the Metal Physics Committee. Visitors are welcome and no tickets are required.

Lecture on "The Theory of the Alloys of Copper"

Professor W. HUME-ROTHERY, O.B.E., F.R.S., has accepted an invitation from the Metal Physics Committee to deliver a lecture on "The Theory of the Alloys of Copper" at a meeting to be held at the Royal Institution, Albemarle Street, London, W.1, on Thursday, 23 February 1961, at 6.30 p.m. Visitors are welcome and no tickets are required.

Lecture on Effect of Electroplating on Fatigue

A lecture entitled "Electroplating Processes: Their Effect on Fatigue Strength and Embrittlement of the Substrate" will be given by Mr. C. WILLIAMS, of the Armament Research and Development Establishment, to the Sheffield and North East Branch of the Institute of Metal Finishing on Friday, 27 January 1961. The meeting will be held at 7.0 p.m. at the Grand Hotel, Sheffield.

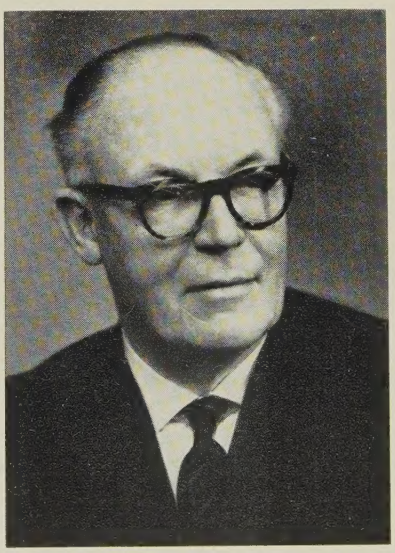
The lecture will be similar to that which Mr. Williams gave recently at a very successful joint meeting of the London Branch of the Institute of Metal Finishing and the London Local Section of the Institute of Metals. Although the meeting in Sheffield is not a joint one between the two societies, members of the Institute of Metals are cordially invited to be present and to take part in the discussion.

PRESENTATION TO THE SECRETARY

At the end of April Lieut.-Colonel S. C. Guillan is to retire as Secretary of the Institute. He will then have completed fifty years of service to the Institute, and it has been agreed by Members of Council that a farewell presentation shall be made to him.

This will take place at a dinner on a date to be arranged in the early part of next year, and it is felt that many members and friends of the Institute will wish to be associated with Members of Council in such a presentation.

Those wishing to subscribe are asked to send their contributions to the Hon. Treasurer, Mr. D. P. C. Neave, at the Institute's address.



Election of Members

The following 17 Ordinary Members, 6 Junior Members, and 2 Student Members were elected on 18 October 1960:

As Ordinary Members

ATES, Franciscus Ferdinand, Metallurgist, Koninklijke Shell-Laboratorium, Amsterdam, Netherlands.

BACKOFEN, Walter Alan, Sc.D., Associate Professor of Metallurgy, Massachusetts Institute of Technology, Cambridge, Mass., U.S.A.

BIRCHON, David, B.Sc., A.I.Mar.E., F.R.M.S., A.I.M., Senior Scientific Officer, Royal Naval Scientific Service, Admiralty Materials Laboratory, Holton Heath.

BLAIR, Alex Charles, B.Sc., A.I.M., Chief Metallurgist, High Duty Alloys, Ltd., Rolling Division, Briton Ferry.

BUOB, Karl Heinz, Dr.sc.nat., Research Engineer, Eidgenössisches Institut für Reaktorforschung, Wurenlingen, Switzerland.

COUCH, William H., B.S., Technical Manager, Simplex Wire and Cable Co., Cambridge, Mass., U.S.A.

EPNER, Martin, M.S., Research Associate, Sintercast Corporation of America, Yonkers, N.Y., U.S.A.

FABIAN, Derek John, B.Sc., Ph.D., Lecturer, Department of Metallurgy, Royal College of Science and Technology, Glasgow.

GJERSEM, Knut, Dipl.-Ing., Head of Laboratory, Kongsberg Våpenfabrikk, Kongsberg, Norway.

HALL, Richard C., Ph.D., Manager of Research, Universal-Cyclops Steel Corp., Bridgeville, Pa., U.S.A.

HOWE, Roy Duncalfe, L.I.M., Metallurgist, United Glass, Ltd., London.

IYER, A. Subramanya, M.S., Ph.D., Metallurgist, Acta Technological Laboratories, Chicago, Ill., U.S.A.

JAMES, Frederick Walter, Joint Managing Director, The Wolverhampton Metal Co., Ltd., Wednesfield, Staffs.

MCWILLIAMS, Thomas Grason, Jr., B.E.S., Instructor in Metallurgy, Department of Chemical Engineering, University of Maryland, College Park, Md., U.S.A.

MEAD, George Sidney, Director, Holman Michell and Co., St. Helens, Lancs.

MICHIELS, John, B.Sc., Ph.D., Laboratoire de Recherches Physiques, Ateliers de Constructions Electriques de Charleroi, Charleroi, Belgium.

SHELTON, Robert Albert John, B.Sc., Lecturer in Metallurgy, University of Manchester.

As Junior Members

BIRD, John, B.Met., Ormlie Lodge, Thurso, Caithness.

CROMPTON, John Michael Gaven, M.Met., Research Investigator, Fulmer Research Institute, Stoke Poges.

DICKSON, John Steele, B.Sc., Metallurgist, Rolls-Royce, Ltd., East Kilbride.

DRAYSEY, John Malcolm, B.Sc., Development Metallurgist, Bristol Aerojet, Ltd., Weston-super-Mare.

HAROCOPOS, Basil, B.A., Metal Science Division, Borough Polytechnic, London, S.E.1.

NOWELL, David, Assistant Experimental Officer, Atomic Energy Research Establishment, Harwell.

As Student Members

MERRICK, Howard Francis, B.Sc., Postgraduate Student, Department of Metallurgy, University College, Cardiff.

WILLIAMS, Cedric David, B.Sc., Postgraduate Student, Department of Metallurgy, University College, Cardiff.

The following 9 Ordinary Members and 17 Student Members were elected on 28 October 1960:

As Ordinary Members

BRUNNER, HANS, M.S., Sc.D., Head, Solid State Physics Laboratory, Boeing Scientific Research Laboratories, Seattle, Wash., U.S.A.

COOPER, Thomas William, B.Sc., Senior Lecturer in Physics and Chemistry, and Supply Officer for X-Rays and Radioactive Substances, Stafford College of Technology, Stafford.

COOPER, William Charles, Lecturer in Charge, Sheet Metal Department, Willesden Technical College, London.

CRANSBERG, Rolf, Dr., Chief, Materials Department, Research Institute of the Algemene Kunstzijde Unie N.V., Arnem, Netherlands.

DUNN, George, Dipl.Mech.Eng., Assistant, Binny's Engineering Works Private, Ltd., Meenambakkam, Madras, India.

ROBERTSON, *Professor* William Donald, D.Sc., Professor and Chairman of the Department of Metallurgy, Yale University, New Haven, Conn., U.S.A.

ROWLETT, Derek Angell, M.Sc., A.I.M., G.I.Mech.E., Metallurgist, Darchem Engineering Co., Ltd., Stillington, Co. Durham.

SOUTHAN, Harold Joseph, L.I.M., Lecturer in Metallurgy, Wolverhampton and Staffordshire College of Technology, Wolverhampton.

KINGSLEY, Gerald Vaughan, A.B., Ph.D., Director of Research, Bohn Aluminum and Brass Corp., Detroit, Mich.

As Student Members

BIRBECK, Jeremy Clive Hallen, Undergraduate, Royal School of Mines, University of London.

CHEW KONG SENG, Undergraduate, Royal School of Mines, University of London.

DAVIES, Hywel Aled, Undergraduate, Royal School of Mines, University of London.

FOXALL, Roger Arthur, Undergraduate, Royal School of Mines, University of London.

JACKSON, Ross, B.Sc., Postgraduate Student in Physical Metallurgy, University of Sheffield.

MOORE, Michael Richard, Undergraduate, Royal School of Mines, University of London.

PASCOE, Richard Terry, Undergraduate, Royal School of Mines, University of London.

PATRICK, Gilbert Martin, Undergraduate, Royal School of Mines, University of London.

POLLARD, Barry, Undergraduate, Royal School of Mines, University of London.

QUIN, John, Undergraduate, Royal School of Mines, University of London.

READMAN, Joseph Michael, Undergraduate, Royal School of Mines, University of London.

RUSSELL, (*Miss*) Carolyn, Undergraduate, Royal School of Mines, University of London.

SHERWOOD, Philip John, Undergraduate, Royal School of Mines, University of London.

TURNER, George Arthur, Undergraduate, Royal School of Mines, University of London.

WAKELIN, David Herbert, Undergraduate, Royal School of Mines, University of London.

WATTS, David Arthur, Student of Metallurgy, Battersea College of Technology, London.

WOLSTENHOLME, David Alan, Undergraduate, Royal School of Mines, University of London.

"Metallurgical Reviews", Vol. 5, No. 19

The latest issue of *Metallurgical Reviews* contains: "Fretting", by P. L. Teed; "The Rare-Earth Metals", by F. H. Spedding and A. H. Daane; and "An Appraisal of the Theory of Deep Drawing", by J. M. Alexander.

Metallurgical Reviews, published quarterly, is available only by annual subscription, the rates being: members 32*s.* 6*d.* ($5.00), post free; non-members 50*s.* ($7.50), post free.

PERSONAL NOTES

Dr. M. Balicki has been elected to full membership in the New York Academy of Sciences.

Mr. J. J. Boex has resigned as a director and executive of The British Aluminium Co., Ltd.

Mr. L. Gwyther has been appointed Chief Metallurgist at the Warrington Factories of The British Aluminium Co., Ltd.

Mr. G. J. Heritier has resigned his position as Chairman and Managing Director of Aeroplane and Motor Aluminium Castings Co., Ltd., for reasons of health.

Mr. A. A. Hinchliffe has left King's College, University of Durham, and taken up an appointment with Rolls-Royce, Ltd., Aero Engine Division, Derby, as a graduate apprentice production metallurgist.

Mr. Josiah W. Jones recently retired from his post as Senior Lecturer in the Department of Aircraft Materials at the College of Aeronautics, Cranfield.

Mr. M. Korchynsky has been appointed Technical Supervisor, Metals Research Group, Technology Department, Union Carbide Metals Co., Niagara Falls, N.Y.

Mr. C. D. T. Minton has left Cambridge University and joined the New Metals Section of the Research Department, Imperial Chemical Industries, Ltd., Metals Division, Birmingham.

Mr. S. O'Hara, of the Research Laboratories, Westinghouse Electric Corporation, has been awarded the Ph.D. degree of Glasgow University.

Major F. Orme has retired from his position as senior lecturer in the Department of Metallurgy, University of Sheffield.

Mr. C. W. Phillips has been appointed Manager of a newly created research services department in the scientific laboratory of the Ford Motor Company, Dearborn, Mich.

Mr. R. S. Pratt has been appointed Technical and Research Director of the Bridgeport Brass Company, Bridgeport, Conn. He has been with the Company since 1920.

Mr. W. J. Thomas has retired from his position as Managing Director of The British Aluminium Co., Ltd., but is continuing as a director of the Company and of certain subsidiary and associated companies.

Dr. R. T. Weiner has left Jessop-Saville, Ltd., and is now with the Atomic Energy Division of The General Electric Co., Ltd., Erith.

Mr. A. W. Williams, of James Booth Aluminium, Ltd., has been appointed chief technical representative in charge of the Company's technical sales service department.

Deaths

The Editor regrets to announce the deaths of:

Mr. Fred Baugh, Managing Director of Alexander Metal Co., Ltd., Bilston, Staffs. He was a prominent member of the British Bronze and Brass Ingot Manufacturers' Association, being its President in 1956–58.

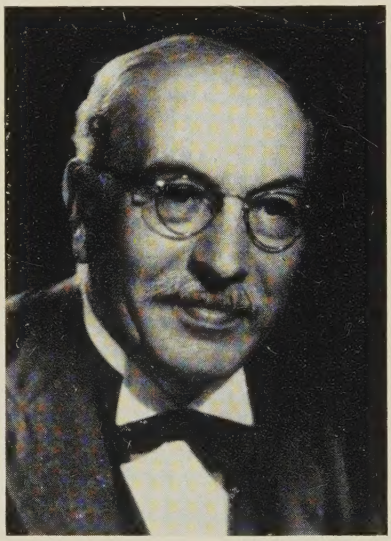
Mr. James Horace Stuart, Chairman of the Scottish Local Section and a Director of E. Chalmers and Co., Ltd., Leith.

Dr. Eric Voce, Chief Metallurgist of the Copper Development Association, on 26 October.

OBITUARY

Professor Pierre Chevenard

Professor P. Chevenard died at Fontenay-aux-Roses (Seine) on 15 August 1960. Pierre Antoine Jean Chevenard was born in 1888 at Thizy (Rhône). He studied at the Ecole des Mines de Saint-Etienne, from which he graduated in 1910 and then took up a post with the well-known firm, Société Anonyme de



Commentry-Fourchambault et Decazeville, with which he was to be associated throughout his life. In the following year he was transferred to the laboratory of their steel works at Imphy (Nièvre). Here his work on nickel–chromium steels was so remarkable that a little over a year later the Director-General of the firm created a new post for him, that of "engineer-in-charge of metallographic research at Imphy", and his job was, in addition to solving the problems in manufacture and the needs of customers, "methodically to study special steels so as to discover and exploit their unusual properties". M. Chevenard was appointed scientific director of the Company in 1935.

In the course of his work, the results of which are well known to all interested in special steels, M. Chevenard designed and made the very large range of instruments which will always be associated with his name, including dilatometers, thermomagnetometers, thermostats, machines for testing the mechanical properties of specimens which had a volume only 1/1000th of that of the standard test-bars, and many others.

With these instruments, M. Chevenard investigated the effects of the transformations in a very large number of special steels, more especially nickel steels with or without additions of chromium, tungsten, cobalt, copper, and other elements, over a range of temperature between −195° and 900° C. He further studied the effect of heat-treating these steels on their resistance to stress-corrosion, both in liquids and gases, and also on their fatigue properties. This work led in the first place to an improvement in the products of the Imphy works and later to the development of new materials, including a heat-resisting alloy for use in the manufacture of ammonia under a pressure of 1000 atm at 600° C, and an alloy for the blades of steam turbines.

Another application of his work lay in the field of horology, where he introduced a variation of Elinvar for use in the balance-wheel springs of chronometers.

In addition to his research work, M. Chevenard took an active part in teaching. He was Professor at the Ecole des Mines at Saint-Etienne, where he had been a student, from 1919 to 1935, and also at the Ecole Superieure de Fonderie from 1923 to 1939. Furthermore, he instituted courses in the works of his firm for apprentices, workmen, &c.

M. Chevenard, who was a Commandeur de la Légion d'Honneur and a Membre de l'Institut de France, was the recipient of many honours. On three occasions he was awarded a prize of the Académie des Sciences (1924, 1935, and 1943). He was a laureat of the Société des Ingénieurs civils de France; of the Société d'Encouragement; of the Société française de Navigation aérienne; and of the Centre national de la Recherche scientifique. He was a former President of the Société française de Physique, the Association technique de Fonderie, and the Société française de Métallurgie. In 1946 he was elected a member of the Académie des Sciences, and in 1947 a doctor *honoris causa* of the University of Liège.

M. Chevenard joined the Institute of Metals in 1926 and was elected an Honorary Member in 1947. For many years he was Honorary Corresponding Member to the Council for France, and at a meeting of the Institute held in Paris in September 1936 he delivered the Autumn Lecture on " The Scientific Organization of Works."

Mr. W. H. A. Robertson

Mr. W. H. A. Robertson, founder of W. H. A. Robertson and Co., Ltd., Bedford, died at his home in Leighton Buzzard on 21 September 1960 at the age of 79.

Walter Henry Antonio Robertson was educated at St. Paul's School and at the age of 17 went as a premium pupil to the famous engineering firm of Maudslay Sons and Field, Lambeth. During his apprenticeship, the first big engineering strike took place, and as a result he had the responsibility of erecting and commissioning the engines for the battleship H.M.S. *Albion*.

After completing his apprenticeship he was employed by the Sturtevant Engineering Company and also by W. H. Allen, Sons and Co., Ltd., Bedford, in their drawing office. In 1904 he joined Elliott's Metal Company, Birmingham, now part of Imperial Chemical Industries, Ltd., Metals Division.

In 1907, at the age of 26, he founded the firm of W. H. A. Robertson and Co., Ltd., Bedford, to manufacture rolling mills and metal-working machinery. He purchased an existing building, 50 × 20 ft in size, and began operations with five employees. Mr. C. E. Davies, who is still an active Director of the Company, joined him at the beginning. The Company expanded throughout Mr. Robertson's life and the works now cover an area of 6 acres and employ about 1250 people.

Mr. Robertson retired from active participation in the management of the business in 1954, but remained a Director until his death. The Company is now part of the Tube Investment organization.

Mr. Robertson was a Member of the Institution of Mechanical Engineers, and a Member of the Institute of Metals, the Iron and Steel Institute, and the Junior Institution of Engineers. It was largely through his initiative, in publishing a letter in the technical press, that the Institute of Metals was formed in 1908, Mr. Robertson being an Original Member.

Mr. Robertson's name will continue to be closely connected with the Institute through the W. H. A. Robertson Medal and

Premium, presented by the Directors of the Company, which are awarded annually by the Council of the Institute to the author(s) of the paper adjudged to be of the highest merit contributed to the *Journal* on engineering aspects of metallurgy.

In 1941 he was responsible for the formation of the Maudslay Society, which consists of old employees and friends of the firm with which he was a pupil, and has as its object the commemoration of the great engineer, Henry Maudslay, who founded the firm. In conjunction with Pembroke College, Cambridge, an award of £400 a year as a Scholarship has now been arranged.

Outside his work, Mr. Robertson was a first-class athlete, having played Rugby football, cricket, and golf.

JOINT ACTIVITIES

Joint Committee for National Certificates and Diplomas in Metallurgy

In recent years, the expansion in the work of the Joint Committee for National Certificates in Metallurgy has thrown an increasing financial burden on the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of Metals, and the Institution of Metallurgists. As there appeared to be no likelihood of improving this position considerably in the near future, it has been agreed between the constituent bodies and the Ministry of Education that, from January 1961, the Ministry, instead of the Institution of Metallurgists, shall be responsible for providing the office administration of the Joint Committee.

Hitherto the Registrar-Secretary of the Institution of Metallurgists has been the Secretary of the Joint Committee. There will in future be Joint Secretaries—the Registrar-Secretary and an officer of the Ministry of Education. All correspondence arising from the work of the Joint Committee should be addressed to the Joint Secretary at the Ministry of Education.

The constitution, membership, and chairmanship of the Joint Committee will remain unchanged. The four institutes and the Ministry are agreed that it is particularly important that the closeness and effectiveness of their co-operation in the work of the Joint Committee should not in any way be reduced by the new arrangements. To this end the arrangements both for the appointment of assessors by the institutes and for detailed consultation as necessary, between the Ministry and the Registrar-Secretary of the Institution of Metallurgists, in the intervals between the meetings of the Joint Committee will remain unaffected.

The four institutes will continue, as hitherto, to provide funds for the award of prizes on the results of the National Certificate examinations.

Local authorities, colleges, and others concerned are being informed officially by the Ministry in circular letter reference F.E.C.L. 18/60, of which the following is the text:

As a result of recent discussions between the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of Metals, the Institution of Metallurgists, and the Ministry of Education, it has been agreed that the following changes shall be made in the arrangements for dealing with the secretarial work of the Joint Committee for the award of National Certificates and Diplomas in Metallurgy:

1. From 1 January 1961 the Secretaryship of the Joint Committee, which is at present the sole responsibility of the Institution of Metallurgists, will become the joint responsibility of the Institution and the Ministry.

2. All correspondence with the Joint Committee about the submission of schemes or any matters arising out of the Rules should in future be addressed to: The Joint Secretary, The Joint Committee for the Award of National Certificates and Diplomas in Metallurgy, Ministry of Education, Curzon Street, London, W.1.

3. To facilitate the change-over, the Institution of Metallurgists will deal with all correspondence relating to the 1960 examinations. Correspondence about the 1961 examinations, including remittances of fees, should be sent to the Ministry of Education.

4. All cheques and postal orders should be made payable to the " Ministry of Education " or Order and should be crossed " Account of H.M. Paymaster General (Metallurgy Examinations.) ".

5. It is particularly emphasized that there is no change in the constitution of the Joint Committee or in its membership or chairmanship, and that the relationship between the constituent bodies of the Joint Committee and the Ministry of Education remains unchanged.

POWDER METALLURGY JOINT GROUP

Symposium on " Practical Aspects of Pressing Metal Powders "

Below are given synopses of twelve papers to be presented at a Symposium on " Practical Aspects of Pressing Metal Powders " on 16 December 1960. The complete papers are published in *Powder Metallurgy*, No. 6, with the exception of that by Martin, Knight, and Ellis. Copies of this will be available to those attending the meeting and it will appear in *Powder Metallurgy* No. 7.

Some Developments in Metal Powder Presses

By J. Oakley
(*The Manganese Bronze and Brass Co., Ltd., Ipswich*)

The requirements of presses for the production of parts from metal powder are listed. The historical development of modern presses from the early adaptations is described, their features being related to the demand for large and more complex shapes and the use of powders that are not easily formed. Reference is made to the difference in approach shown in the American multi-motion presses and the Continental combination of simple presses with complex tools used as a sub-press assembly.

Some Fundamental Studies in the Cold Compaction of Plastically Deforming Solids

By D. Train and J. A. Hersey
(*School of Pharmacy, University of London*)

Studies have been made of the behaviour under compression of materals which exhibit plastic deformation at normal temperatures, as exemplified by indium and lead. In particular, attention has been focused on the effects of die-wall friction and on the influence of the relative volume. The die-wall friction effects produced by a solid plug of the material were compared with those produced by a particulate fill of the same material when compressed under similar conditions, and a correlation of these effects with the shear strength of the material was made. A theoretical equation relating relative volume at either end of the compact is suggested.

Determination of Hoop Stresses Induced in a Cylindrical Steel Die by Compacting Metal Powders

By S. J. Bustamante and H. Sheinberg
(*Los Alamos Scientific Laboratory, University of California, Los Alamos, U.S.A.*)

Because of the lack of stress data, steel dies for compacting metal powders were designed in the past on the assumption of hydraulic pressure transmission by powders.

True die stresses existing in a hardened steel die during the compacting of various lubricated and non-lubricated powders have been measured by mounting strain-gauges on the periphery of the die at numerous points along its length.

Value of the hoop stress varied from approximately 0·05 to 0·40 of the calculated and measured hydraulic fluid stress. For a particular metal powder, the stress was a function of the average particle size, the powder height, and the amount of lubrication.

The Displacement of Gas from Powders During Compaction

By W. M. Long and J. R. Alderton

(*Atomic Weapons Research Establishment, Aldermaston, Berks.*)

A soap-bubble method was used to observe in detail the flow of gas out of powder masses during and immediately after compaction. The effects of powder material and size distribution, die size, pressing speed, and degree of compaction were investigated. The amount of gas trapped in the compact at completion of pressing varied from 12 to 83% of the initial amount of gas present in the spaces between the powder particles, over the range of compaction conditions studied. As expected, the amount trapped increased with increase in die size, with increase in pressing speed, and with decrease in particle size. Very little gas escaped during the latter stages of compaction even at slow pressing speeds. The effect of a small punch/die clearance was examined in typical cases and shown to be minor, except with a coarse powder pressed at a high speed.

That trapped gas can produce cracks was demonstrated by making compacts containing varying amounts of trapped gas, other conditions remaining constant. With the particular powder used, once the amount of trapped gas had passed a certain level, the compacts tended to be fairly badly cracked. It appears, however, that cracks due to gas pressure alone tend to occur only when powders are rapidly compacted to very high densities.

Radial Pressures in Powder Compaction

By W. M. Long

(*Atomic Weapons Research Establishment, Aldermaston, Berks.*)

A simple theory is advanced to explain the variation of radial (die-wall) pressure during compaction in conventional dies. The theory predicts that during the application and release of pressure by the punch, the radial pressure should follow a characteristic cycle whose form is determined by the elastic properties and by the yield stress in shear of the material which is being pressed. The theory is supported by experimental radial pressure determinations on a range of materials.

The theory accounts for the residual radial pressures which dies continue to exert on compacts after removal of the punch pressure; according to the theory, these residual pressures arise through shearing of the pressed material, and have maximum values which are determined by the shear strength of the material. The mechanism of production of capping and laminar cracks by residual radial pressures is discussed in detail.

An apparatus for the measurement of radial pressures and powder/die friction coefficients at moderately high temperatures is described.

The Influence of Tooling Methods on the Density Distribution in Complex Metal-Powder Parts

By H. G. Taylor

(*Höganäs-Billesholms A.B., Höganäs, Sweden*)

The theoretical movements required for the various moving tool elements during the pressing cycle are examined for several typical component sections. These theoretical movements are then compared with the actual movements of the moving tool elements in various types of tooling. The conclusion is reached that the conventional tool designs vary greatly from the ideal in many ways, permitting uncontrolled lateral powder movement during pressing and causing excessive density variation in the pressed compact.

Three major problems are apparent:

1. The use of a solid die for pressing compacts with varying section thicknesses results in an "average" die movement which is always too great for the thicker section and too small for the thinner section.

2. The double function of the floating punch, which takes vertical pressure on its horizonal face while its vertical face acts as a die, presents a very difficult problem. The floating punch movement, controlled by its horizontal face, is always greater than the correct movement required to give minimum density variation in the portion of the compact formed by the vertical surface of the punch.

3. The various types of support used for floating punches rarely provide the correct timing, sufficient maximum load, or progressively increasing resistance essential to ensure equal density distribution within the powder during the pressing operation.

Suggestions for tooling, designed to solve some of these problems, are discussed.

The Compacting of Metal Powders by Explosives

By W. T. Montgomery and H. Thomas

(*Research and Development Department, Imperial Chemical Industries, Ltd., Nobel Division, Stevenston, Ayrshire*)

The paper describes a technique developed for compacting metal powders by the use of detonating explosives under controlled conditions. Aluminium, iron, copper, and steel powders were originally compacted by this means into solid cylinders. Graphite and other non-metal powders have recently been compacted, and modifications have been introduced whereby annular cylinders may be formed. This novel technique may find application in cases where existing mechanical methods of powder compacting are not adequate.

Aspects of the Volume Production of Green Porous Bearing Compacts

By M. A. Pound, A. E. S. Rowley, and J. E. Elliott

(*Bound Brook Bearings Ltd., Lichfield, Staffs.*)

The history and methods of manufacture of self-lubricating porous metal bearings are briefly outlined. The importance of achieving appropriate quality at each stage of manufacture, and particularly during compacting, is emphasized, and the qualities desired in a green bearing compact are detailed. Various factors relating to the economic large-scale manufacture of green bearing compacts are then considered. The virtues of elemental powders and the influence of lubrication upon powder mix properties and pressing and ejection of compacts are discussed. The special powder-flow problems associated with long, thin-walled bearings and the advantage, in this respect, of a moving core rod are described. The particular difficulties encountered in compacting such bearings are stated, and special consideration is given to the ejection problems involved. It is concluded that limitations of bearing length and wall section must be accepted.

The Processing of Enriched Uranium Oxide/Paraffin Wax Mixtures

By L. D. Huckstepp and G. V. Day

(*Atomic Weapons Research Establishment, Aldermaston, Berks.*)

A process for the production of 1-in. cubes in an inert gas atmosphere, from enriched uranium oxide and paraffin wax powder mixtures is described. A general description of the type of equipment used is given and the procedure and safety

precautions required for handling this type of radioactive material are outlined.

Hot Pressing of Ceramic Powders

By A. G. Thomas and H. J. Jones

(*The Plessey Co., Ltd., Caswell Laboratories, Towcester, Northants.*)

The process involved in the production of dense ceramics from powder materials by the simultaneous effect of pressure and heat at temperatures above 1500° C are outlined. The factors leading to the choice of this method of fabrication, and the general principles involved in hot pressing, are first dealt with, and the advantages and disadvantages of the process are then discussed. Current techniques are described and their limitations considered. Examples of typical applications are given, and possible lines of future development are indicated.

The Isostatic Pressing, Vacuum Sintering, and Swaging of Thorium Powder

By H. Lloyd and A. E. Symonds

(*Atomic Energy Research Establishment, Harwell, Berks.*)

The isostatic pressing of calcium-reduced thorium powder into round bars and tubes, prior to vacuum sintering and swaging, is described. The simple equipment allows powder filling to be carried out in an enclosed system, thus avoiding fire and health hazards at this stage. A number of bars or tubes, of varying length and diameter, can be pressed simultaneously. The technique has certain advantages over conventional die compacting.

The effect of pressure on density and hardness through the bar section before and after sintering at various temperatures has been studied, and the optimum conditions determined for the manufacture of dense bars with high metal efficiencies (98%). Details are given of the microstructure and mechanical properties of thorium bars in the sintered, swaged, and annealed conditions.

The Forming of Hollow Shapes in Beryllium by Loose Sintering and Hot Pressing

By A. J. Martin, R. A. Knight, and G. C. Ellis

(*Atomic Weapons Research Establishment, Aldermaston, Berks.*)

Two methods for forming shaped bodies in beryllium by powder metallurgy are described and compared. The requirements for uniform densification during hot pressing are discussed, and it is concluded that a double-pressing method is essential if thin-walled hemispherical shapes are required.

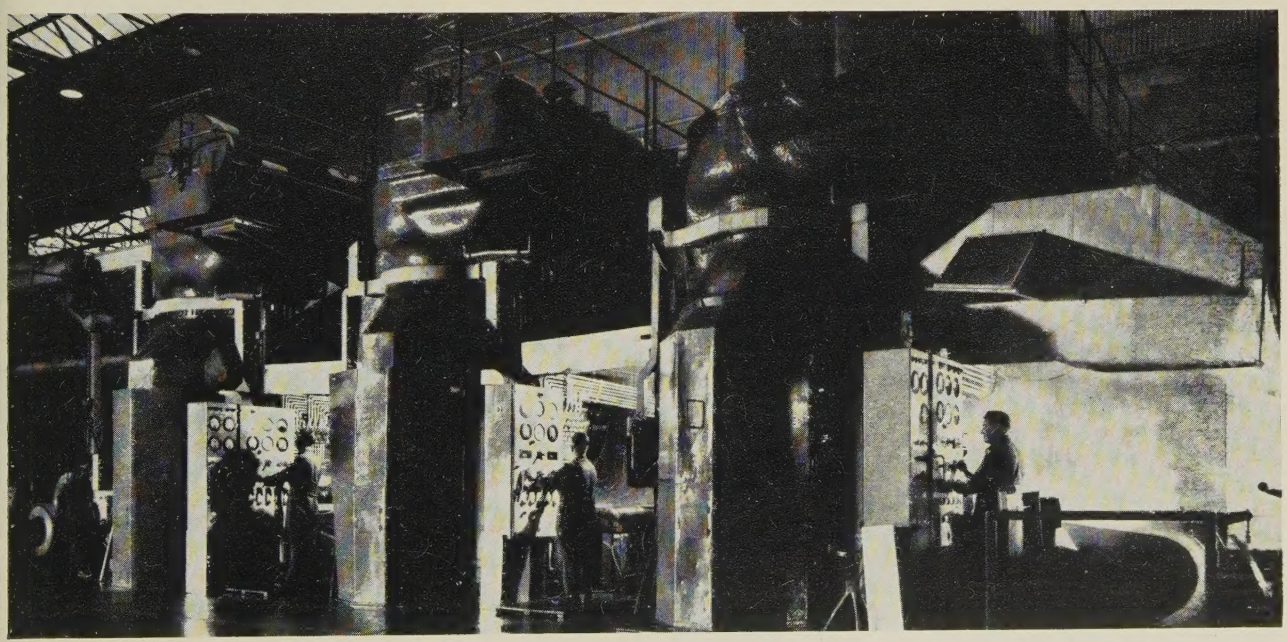
Powder Metallurgy, which appears twice a year, is the official organ of the Powder Metallurgy Joint Group. It is obtainable by annual subscription at 25*s.* (post free) to non-members; members of The Iron and Steel Institute and The Institute of Metals may obtain it for an annual fee of 10*s.* (post free).

OTHER NEWS

Expansion at the Rogerstone Works of Alcan Industries, Ltd.

The half-way stage in a four-year development scheme at the Rogerstone Works of Alcan Industries, Ltd. (formerly Northern Aluminium Co., Ltd.), was reached recently when some of the new equipment, including a 144-in. hot mill, came into operation.

The scheme consists of improvements to the existing continuous strip mill laid down in 1949 and 1950. It covers the installation of new equipment, the modernization of some existing equipment to increase operating speed and versatility, and at several points the relocation of plant to improve flow in the mill. When the work is completed in 1962, the nominal output of sheet and strip will be raised from 50,000 to 70,000 tons a year, plus a substantial extra capacity for hot-rolled coil and plate. A considerable proportion of the output will be of material made from the stronger alloys, and also of aluminium alloy plate, which will be available in substantially greater



Three-stand tandem mill at Rogerstone Works.

widths than hitherto. The plate, to a maximum width of well over 10 ft, will be rolled by the new 144-in. hot mill, which is the biggest item of new equipment being installed.

The mill has been set at the head of the original third-of-a-mile-long hot line, which comprised a breaking-down mill, an intermediate hot mill, and a two-stand tandem hot finishing mill. With the addition of the new 144-in. mill, which can be used either on its own, for rolling plate, or in line, the intermediate hot mill is to be removed and a third stand has been added to the hot finishing mill. In addition, new equipment has been introduced for shearing, edge-trimming, and coiling at appropriate positions in the hot line, and additional pre-heat furnaces have been laid down. The original cold-rolling facilities, comprising a three-stand tandem mill and a temper mill, are also being augmented by a two-stand tandem mill.

The layout for hot rolling, in which the ingot passes through a series of mills to emerge as strip, consists of the following: a 144-in. four-high mill (which can be used either as the breaking-down mill for the hot line or on its own for rolling plate), a 96-in. two-high mill (which can serve the hot line either as a breaking-down mill or an intermediate roughing mill), and three 88-in. four-high hot-finishing mills working together as a three-stand mill in tandem; on emerging from the last stand, the strip passes through an edge trimmer and immediately to a down-coiler.

This 144-in. mill, at its installation the biggest and most powerful in Europe for rolling aluminium, will produce plate well over 10 ft wide and down to $\frac{3}{4}$ in. thick. It is driven by two 4000-h.p. dc motors linked to the top and bottom work-rolls, which can be very quickly reversed for each pass.

As aids to efficient rolling, the thickness of the slab is automatically indicated by a gamma-ray gauge located on the outgoing side of the mill, and the screwdown has been designed for future operation with automatic gauge control.

Plate emerging from the mill finish-rolled is ejected on to a table that carries it to a slab shear for end-shearing, after which it is removed from the hot line. If it is thick plate required for aircraft use, it is then taken away for heat-treatment, stretching, sawing, and ultrasonic inspection.

On the other hand, ingot that has been only broken down by the 144-in. mill passes down the hot line to the 96-in. hot roughing mill. This mill also acts as a breaking-down mill for smaller ingots preheated in tunnel furnaces alongside it when the 144-in. mill is engaged on rolling plate.

Slab leaving the 96-in. mill passes through an edge-trimmer and end-shear (which will edge-trim slabs up to 200 ft long without interfering with other operations of the line), then moves forward for hot finishing. Since the three 88-in. mills carrying out this operation work together in tandem, their speeds are closely controlled so that the strip passing between them does not suffer undue tension or slack. The first two mills are powered by 4000-h.p. motors and the third by a 2600-h.p. motor and all are non-reversing, the strip passing through them only once. It is then edge-trimmed again and finally coiled on a mandrel down-coiler, some 25 ft from the third stand.

" Metallurgy—the Study and Use of Metals "

A pamphlet entitled " Metallurgy—the Study and Use of Metals " has been prepared by the Institution of Metallurgists and is being distributed by the Ministry of Labour, on behalf of the Institution, to all schools in the United Kingdom that have a science sixth form, and to all Youth Employment Officers.

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF SUPPLY

Defence Standards Laboratories, Melbourne.

Applications are invited for positions of

HIGHER SCIENTIFIC OFFICER

SALARY: £2005–2265 (Australian Currency)

in the following two categories:—

CHEMISTRY OF METALS

DUTIES: Research into chemical aspects of the properties of metals and alloys, especially those which have been highly refined. QUALIFICATIONS: Honours degree with Chemistry as a major subject. Some relevant experience an advantage.

ELECTRODEPOSITION

DUTIES: Investigational work in the field of electrodeposition. This includes studies on electrode reactions, structures, and properties of electrodeposits, alloy deposition, and electrowinning of pure metals. QUALIFICATIONS: Honours degree in Engineering or Science with Chemistry or Metallurgy as a major subject.

NOTE: Applicants who do not have the necessary experience may initially be appointed as Scientific Officer, Grade 1 (£1510–1895) and at a later date may be promoted to Higher Scientific Officer.

TRAVEL: Under specified conditions, first class air/sea transport for the appointees and dependents (wife and dependent children) will be provided by the Commonwealth.

CONTRACT EMPLOYMENT: If desired by the successful candidates consideration may be given to entering into an agreement for a three (3) or five (5) year contract of employment in Australia. In this case the Commonwealth will bear the cost of return fares; together with the cost of removing the successful applicants' furniture and effects up to a maximum cost of £500 (Australian), £250 each way.

APPLICATIONS: Forms obtainable from Senior Representative (AV 81/10), Department of Supply, Australia House, The Strand, London, W.C.2, with whom completed applications should be lodged as soon as possible.

DIARY

The Institute

12 January. "Metallurgical Research at High Pressures", by Dr. J. E. Hilliard. (17 Belgrave Square, London, S.W.1, at 6.30 p.m.)

3 January. Oxford Local Section. "Meteorites", by by Dr. H. J. Axon. (Cadena Café, Cornmarket Street, Oxford, at 7.15 p.m.)

4 January. Leeds Metallurgical Society. "Some Recent Developments in the Welding of Metals", by E. N. Gregory. (Bradford Institute of Technology, at 6.30 p.m.)

5 January. Birmingham Local Section. "Vacuum Technology", by T. Thorley. (College of Technology, Gosta Green, Birmingham, at 6.30 p.m.)

5 January. London Local Section. "Metallurgy in Electronics", by Dr. J. E. Hughes. (17 Belgrave Square, London, S.W.1, at 6.30 p.m.)

11 January. Manchester Metallurgical Society. "Modern Methods of Metallurgical Analysis", by K. M. Bills. (The Manchester Literary and Philosophical Society, George Street, Manchester, at 6.30 p.m.)

12 January. East Midlands Metallurgical Society. "The Metallurgy of Semi-Conductors", by J. G. Wilkes. (Derby and District College of Art, Derby, at 7.30 p.m.)

17 January. South Wales Local Section. "Metals and Alloys Used in the Jewellery and Silverware Industry", by Miss D. L. Pile. (The Royal Institution, Swansea, at 7.0 p.m.)

19 January. Birmingham Local Section. "The Heat-Treatment of Engineering Components", by E. Mitchell. (College of Technology, Gosta Green, Birmingham, at 6.30 p.m.)

19 January. Liverpool Metallurgical Society. Papers will be presented by members of the University of Liverpool Metallurgical Society and the new Laboratories will be open for inspection. (Department of Metallurgy, University of Liverpool, at 7.0 p.m.)

19 January. North East Metallurgical Society. "The Effects of Nuclear Radiation on Metals", by Dr. H. M. Finniston. (Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough, at 7.30 p.m.)

19 January. Sheffield Local Section. "Ductile Fracture", by Professor R. W. K. Honeycombe. (Applied Science Building, The University, St. George's Square, Sheffield, at 7.30 p.m.)

25 January. Manchester Metallurgical Society. "The X-ray Microanalyser as a Research Tool for the Metallurgist", by Dr. D. A. Melford. (Manchester Literary and Philosophical Society, George Street, Manchester, at 6.30 p.m.)

CHEMISTS

METALLURGISTS

PHYSICISTS

The Atomic Power Division, which is situated in rural surroundings at Whetstone (nr. Leicester), invites enquiries from Chemists, Metallurgists and Physicists who are interested in participating in a research and development programme covering the following fields: (previous experience in these fields is by no means essential).

1. Chemical problems arising from the novel service and safety conditions in nuclear power plant.

2. High temperature corrosion studies of reactor materials in pressurised CO_2, the aqueous corrosion of magnesium alloys, and the protection of plant against atmospheric corrosion.

3. Metallurgical problems associated with the use of ferrous materials and non-ferrous materials in nuclear reactors, assessment of the effects of radiation on their properties and advising designers on their use.

4. Physical and chemical studies on the oxidation and irradiation of graphites and the effects of these processes on their physical and mechanical properties.

The appointments are permanent and pensionable, and assistance will be given with initial accommodation. Enquiries, giving details of previous experience, qualifications and current salary (which will be treated in strictest confidence) to the Technical Staff Officer at the address below:

(Please quote Reference No. 1814T)

Group Personnel Services, English Electric House, Strand, London, W.C.2

ENGLISH ELECTRIC

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF SUPPLY

CRYSTAL PHYSICS

Applications are invited for the following vacant position at the Defence Standards Laboratories, Maribyrnong, Victoria:—

POSITION: SENIOR SCIENTIFIC OFFICER

SALARY: £2460–£2655 (Australian currency)

DUTIES: (Pos. No. 53) To take charge of a section engaged in applying X-ray crystallography and electron microscopy to structural problems arising from the chemical, physical, and metallurgical work of D.S.L. including interpretation of results; also applying X-ray diffraction to metallurgical examinations and chemical analysis.

QUALIFICATIONS: Honours degree in Physics and several years relevant experience.

TRAVEL: Under specified conditions, first class air/sea transport for the appointee and dependents (wife and dependent children) will be provided by the Commonwealth.

CONTRACT EMPLOYMENT: If desired by the successful candidate consideration may be given to entering into an agreement for a three (3) year contract of employment in Australia. In this case the Commonwealth will bear the cost of return fares; together with the cost of removing the successful applicant's furniture and effects up to a maximum cost of £500 (Aust.), £250 each way.

APPLICATIONS: Forms obtainable from Senior Representative (AV 82/8) Department of Supply, Australia House, Strand, London W.C.2, with whom completed applications should be lodged as soon as possible.

QUALIFIED METALLURGIST

aged about 32, required for well-equipped Research Department of large copper and copper alloy manufacturer, situated in a country district in the North Midlands. The Department is responsible for both research and control of materials throughout the works. Immediate duties will be on investigation and development of existing and new processes in the works. Good prospects of advancement to senior position for a man with drive and initiative, and able to control staff. Previous experience, preferably in copper and copper alloy manufacture, is essential.

Applications, giving details of qualifications and experience, should be addressed to Box No. 459,

The Institute of Metals,
17 Belgrave Square, London, S.W.1

EXTRACTION METALLURGIST required on three-year contract for new electro-metallurgical plant in Southern India, manufacturing manganese and other alloys. Production experience essential. Age preferably 35 to 45. Salary up to £2,500 p.a., depending upon qualifications and experience. Accommodation provided. Box No. 460, The Institute of Metals, 17 Belgrave Square London, S.W.1.

THE FULMER RESEARCH INSTITUTE has a vacancy for a GRADUATE IN METALLURGY to carry out research on PROCESS METALLURGY, HEAT-RESISTING MATERIALS, CERAMICS, &C.

Salary in the region of £1,250 p.a.

Applications should be addressed to:

Director of Research,
Fulmer Research Institute Ltd.,
Stoke Poges,
Buckinghamshire.